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EXAMINER
TALMAN, JAMES R

ART UNIT	PAPER NUMBER
3709	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/710,555	PRIATNA ET AL.	
	Examiner	Art Unit	
	James R. Talman	3709	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 July 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *7/20/2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities:

On page 5, line 6, "spectrally selective" should be changed to --spectrally-selective--.

On page 15, line 18, "78" should be changed to --76--.

On page 17, line 18, "92" should be changed to --96--.

On page 17, line 18, "k-space," should be changed to --k-space segment--.

On page 19, line 12, "few number of segments are needed" should be changed to --small number of segments can be used--.

On page 19, line 15, "is played out more often " should be changed to --can be larger--.

On page 19, line 17, "played out" should be changed to --increased--.

Appropriate correction is required.

Drawings

2. The drawings are objected to because on Figure 3, the "76" on the right hand side of the figure should be changed to --80--. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be

labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

3. Claims 9, 22, and 28 are objected to because of the following informalities:

As per claims 9 and 22, "spectrally selective" should be changed to –spectrally-selective--.

As per claim 28, "Lamour" should be changed to "Larmor."

Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claims 7, and 25-27 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

As per claim 7, the step for determining a flip angle such that the fat magnetization is at or near a null point is not clearly disclosesd.

As per claim 25, the step for automatically determining a flip angle such that the fat magnetization is at or near a null point is not clearly disclosed.

As per claims 26 and 27, the functional relationship between flip angle and encoding scheme is not disclosed.

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 3, 21 and 25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

As per claim 3, the adjective “full-fat-recovery-free” is vague and indefinite.

As per claim 21, the phrase “uniformly fat suppressed” is vague and indefinite.

As per claim 25, the adjective “automatically” is vague and indefinite.

Claim Rejections - 35 USC § 102

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. Claims 1, 11,12, and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by Ma (US patent No. 6016057).

As per claim 1, Ma discloses a method of medical imaging using zero-filling of at least a portion of k-space (column 5, lines 13-41), and also discloses using a fat suppression pulse to suppress signals from fat in an MR image (STIR technique, column 1, lines 19-37). Furthermore, data from the ROI must inherently be acquired at some point prior to full fat recovery, because in principle full fat recovery takes an infinite time to occur. Furthermore, it is inherently necessary to fill at least a portion of k-space with actual MR data because otherwise the entire k-space matrix would be full of zeros, and the reconstructed image would be entirely white or black, depending on the polarity of gray-scale mapping used.

As per claim 11, it is noted that "uniformly fat-suppressed" refers to MR data collected in which all of the data is collected before the fat magnetization has fully recovered. But, since the fat magnetization takes an infinite length of time to truly fully recover, all fat-suppression MR techniques can be said to be "uniformly fat-suppressed". Thus, it is inherent that Ma acquires data in a "uniformly fat-suppressed" fashion.

As per claim 12, Ma does not explicitly disclose any breath-holding requirement and therefore implies the use of a non-breathold technique.

As per claim 16, Ma further discloses imaging of the liver and breast (column 1, line 14).

10. Claim 28 is rejected under 35 U.S.C. 102(b) as being anticipated by Kassai et al (US patent application publication No. 2002/0188190).

Kassai discloses an MR apparatus having means for exciting nuclei (transmitter, 8T) in a substantially uniform field (with the Larmor frequency, paragraph 6), acquiring 3D MR data during a breathold (breath hold during three dimensional scanning, see abstract), and a fat suppression pulse (paragraph 19).

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 2-10, 13,15, and 17-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma as applied to claim 1 above, in view of Haacke et al (Magnetic Resonance Imaging, Haacke, E., et al., John Wiley and Sons, 1999).

As per claim 2, Ma discloses all the elements of the invention except it does not explicitly disclose using segmented data acquisition, multiple slice encoding lines, or repeating application of the fat suppression pulse.

Haacke et al disclose segmented data acquisition (Section 19.2, page 516). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Ma to use segmented data acquisition in order to allow multiple lines of k-space to be acquired from each RF excitation of the sample.

Haacke et al further disclose slice encoding (phase encode the slice, Section 20.3.5, p. 594). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to include slice encoding to permit 3D MR imaging.

Haacke et al further disclose an inversion recovery sequence using repeated application of the fat suppression pulse (Figure 17.5, page 428). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to use repeated application of the fat-suppression pulse because the fat magnetization recovers somewhat over time and it becomes necessary to re-suppress it using a fat-suppression pulse.

As per claim 3, the Ma/Haacke et al combination as applied to claim 2 above discloses all the elements of the claimed invention except that it does not explicitly disclose filling k-space with full-fat-recovery-free MR data. But the MR data must inherently be full-fat-recovery-free because in principle full fat recovery takes an infinite time to occur.

As per claim 4, Ma does not explicitly disclose filling k-space from the center outward to the periphery. Haacke et al discloses a k-space trajectory starting near the middle of k-space and proceeding toward the periphery of k-space (Figure 10.16b, p.

192). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to use the center-to-periphery trajectory taught by Haacke et al because larger signals occur near the beginning so the central part of k-space would have higher SNR and the resulting image would have better resolution of coarse objects in the resulting image.

As per claim 5, Ma does not explicitly disclose determining a flip angle such that fat signals are acquired at or near a null point at the filling of k-space. However, Haacke et al discloses determining a flip angle (inversion, Figure 17.6, p. 429) for the fat magnetization, followed by collecting data near the null point of the fat magnetization. It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to collect data near the null point of the fat magnetization because it is where the fat signal is smallest, resulting in best contrast between fat and water, and to use the center-to-periphery trajectory taught by Haacke et al because larger signals occur near the beginning so the central part of k-space would have higher SNR and the resulting image would have better resolution of coarse objects.

As per claim 6, Ma does not explicitly disclose a k-space trajectory proceeding generally from the periphery toward the center. Haacke et al further discloses a k-space trajectory starting near the periphery of k-space and proceeding generally toward the center of k-space (Figure 10.16c, p. 192). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to use the periphery-to-center trajectory taught by Haacke et al because larger signals

occur near the beginning of data collection so the peripheral part of k-space would have higher SNR and the resulting image would have better high-frequency edge contrast in the resulting image.

As per claim 7, Ma does not explicitly disclose determining a flip angle such that fat signals are acquired at or near a null point at the filling of k-space. Haacke et al discloses determining a flip angle (inversion, Figure 17.6, p. 429) for the fat magnetization, followed by collecting data near the null point of the fat magnetization. It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Ma to collect central k-space data near the null point of the fat magnetization because it is where the fat signal is smallest, resulting in better contrast between fat and water.

As per claim 8, Ma discloses all the elements of the claimed invention except that it only applies zero filling in the phase-encoding and frequency-encoding directions and does not explicitly disclose zero filling in the slice encode direction. Haacke et al disclose zero-filling of 3D data (p.812). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to include zero-filling of 3D data in the slice direction to improve the apparent resolution of the image in the slice direction.

As per claim 9, Ma discloses all the elements of the claimed invention except that it does not explicitly disclose using a spectrally-selective inversion recovery pulse. Haacke et al discloses a spectrally-selective (sinc pulse) inversion recovery pulse (Figure 17.5, p. 428). It would have been obvious to a person having ordinary skill in

the art at the time of the invention to include a spectrally-selective inversion recovery pulse because it only excites the spins significantly in a rectangular region, thereby reducing ghost artifacts in the final reconstructed image.

As per claim 10, Ma discloses all the elements of the claimed invention except that it does not explicitly disclose any of the standard image sequences claimed. Haacke et al discloses echo planar imaging in the context of an inversion recovery sequence (p. 429). It would have been obvious to a person having ordinary skill in the art at the time of the invention to use echo planar imaging to collect the MR data in order to shorten the scan time and reduce motion image artifacts.

As per claim 13, Ma discloses all the elements of the claimed invention except that it does not explicitly disclose the use of sequential sampling and filling of k-space. Haacke et al discloses sequential sampling and filling of k-space (sequential ordering is the most commonly used ordering of phase encoding steps, p. 191; also see Figure 10.16a, p. 192). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Ma to use sequential sampling and filling of k-space as it is the most conventional approach and is well known in the art.

As per claim 15, Ma discloses all the elements of the claimed invention except that it does not explicitly disclose the step of defining a 3D volume of interest and acquiring the data therefrom. Haacke et al disclose the use of 3D volumetric imaging using phase encoding in the slice direction in order to collect 3-dimensional data from a collection of voxels in instead of the more common approach of collecting data in 2-dimensional slices. It would have been obvious to a person having ordinary skill in the

art at the time of the invention to use 3D volumetric imaging, as taught by Haacke et al, in conjunction with the invention of Ma in order to obtain higher spatial resolution in the slice encoding direction than using conventional 2D imaging.

As per claim 17, Ma discloses all the elements of the claimed invention except that it does not explicitly disclose the step of reconstructing a magnetic resonance angiography image from the MR data. Haacke et al disclose the method of magnetic resonance angiography (p. 12). It would have been obvious to a person having ordinary skill in the art at the time of the invention to apply the method of Ma to magnetic resonance angiography in order to image blood vessels.

As per claim 18, Ma discloses an MRI apparatus with substantially uniform fat suppression (reliable water and fat separation can be achieved..., column 11, line8), using gradient coils (14), an RF transceiver system (36), an RF switch (24), a computer (10) programmed to define the ROI, zero-filling of at least a portion of k-space (column 5, lines 13-41), and applying a fat-suppression pulse (STIR technique, column 1, lines 19-37). Furthermore, Ma inherently discloses acquiring MR data prior to full fat recovery (or "less-than-full-fat-recovery") because in principle fat takes an infinite length of time to fully recover and therefore data is always acquired prior to full fat recovery. Ma does not explicitly disclose repeatedly applying the fat suppression pulses. Haacke et al disclose an inversion recovery sequence using repeated application of the fat suppression pulse every TR seconds (Figure 17.6, page 429). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to use repeated application of the fat-suppression pulse because

the fat magnetization recovers somewhat over time and it becomes necessary to re-suppress it using another fat-suppression pulse.

As per claim 19, Ma does not explicitly disclose any breath-holding requirement and therefore implies the use of a non-breathold technique.

As per claim 20, Ma does not explicitly disclose the use of sequential sampling and filling of k-space. Haacke et al discloses sequential sampling and filling of k-space (sequential ordering is the most commonly used ordering of phase encoding steps, p. 191; also see Figure 10.16a, p. 192). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Ma to use sequential sampling and filling of k-space as it is the most conventional approach and is well known in the art.

As per claim 21, it is noted that "uniformly fat-suppressed" (as best understood by the examiner) refers to MR data collected in which all of the data is collected before the fat magnetization has fully recovered since it is not possible to collect all data at the brief instant at which the fat magnetization is zero. But, since the fat magnetization takes an infinite length of time to truly fully recover, all fat-suppression MR techniques can be said to be "uniformly fat-suppressed." Thus, it is inherent that Ma acquires data in a "uniformly fat-suppressed" fashion.

As per claim 22, Ma does not explicitly disclose using a spectrally-selective inversion recovery pulse. Haacke et al discloses a spectrally-selective (sinc pulse) inversion recovery pulse (Figure 17.5, p. 428). It would have been obvious to a person having ordinary skill in the art at the time of the invention to include a spectrally-

selective inversion recovery pulse because it only excites the spins significantly in a rectangular region, thereby reducing ghost artifacts in the final reconstructed image.

As per claim 23, Ma discloses a computer (10), defining a slice direction (column 12, line 65), zero-filling a portion of k-space, zero-filling of at least a portion of k-space (column 5, lines 13-41), and applying a fat-suppression pulse (STIR technique, column 1, lines 19-37). Furthermore, Ma inherently discloses acquiring MR data prior to full fat recovery (or "less-than-full-fat-recovery") because in principle fat takes an infinite length of time to fully recover and therefore data is always acquired prior to full fat recovery. Ma does not explicitly disclose zero-filling in the slice direction or repeated application of the fat suppression pulse.

Haacke et al disclose zero-filling of 3D data in the slice direction (p. 812). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to include zero-filling of 3D data to improve the apparent resolution of the image in the slice direction.

Haacke et al further disclose an inversion recovery sequence using repeated application of the fat suppression pulse every TR seconds (Figure 17.6, page 429). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify the invention of Ma to use repeated application of the fat-suppression pulse because the fat magnetization recovers somewhat over time and it becomes necessary to re-suppress it using another fat-suppression pulse.

As per claim 24, Ma does not explicitly disclose sequentially sampling and filling the non-zero portions of k-space. Haacke et al discloses sequential sampling and filling

of k-space (sequential ordering is the most commonly used ordering of phase encoding steps, p. 191; also see Figure 10.16a, p. 192). It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Ma to use sequential sampling and filling of k-space as it is the most conventional approach and is well known in the art.

As per claim 25, Ma does not explicitly disclose filling the center of k-space when the signal from fat is near its null point. Haacke et al discloses determining a flip angle (inversion, Figure 17.6, p. 429) for the fat magnetization, followed by collecting data near the null point of the fat magnetization. It would have been obvious to a person having ordinary skill in the art at the time of the invention to modify Ma to collect central k-space data near the null point of the fat magnetization because it is where the fat signal is smallest, resulting in best contrast between fat and water.

As per claims 26 and 27, the limitations of the claim are rejected for reasons similar to those stated with regard to claims 24 and 25 above, wherein the flip angle is determined as a function of a sequential sampling encoding scheme. The exact value of flip angle used to accomplish fat nulling is an obvious design choice that will depend on the particular value of TR chosen for the sequence, on the value of T1 for the fat being suppressed, and on the interval between the flipping pulse and the instant when fat nulling is desired, as discussed in Haacke et al (Section 18.1.1, pp. 454-460).

13. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ma (US patent No. 6016057) as applied to claim 1 above, in view of Bellemann et al (Drug-Specific F19 NMR and Dynamic F-18 PET Imaging of the Cytostatic Agent 5-

Fluorouracil, Bellemann, M.E. et al, IEEE Transactions on Nuclear Science, Volume 41, No. 6, December, 1994).

Ma discloses all elements of the claimed invention except that it does not explicitly disclose using a fast gradient echo sequence (FGRE). Bellemann discloses using a fast gradient echo sequence (see abstract). It would have been obvious to a person having ordinary skill in the art at the time of the invention to use an FGRE sequence combined with the invention of Ma in order to reduce the scan time.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James R. Talman whose telephone number is 571-270-3029. The examiner can normally be reached on 7:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynda Jasmin can be reached on 571-270-3033. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

James R Talman
Examiner
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Jrt

BENNY TIEU
PRIMARY EXAMINER